SYNOPSIS

"STUDY OF NON SCALP HAIR IN THE DETECTION OF COMMONLY ABUSED PSYCHOACTIVE DRUGS "

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INTRODUCTION

Forensic trichology plays a significant role in criminal justice system. Hair is encountered as physical evidence in many crime cases such as murder, drug facilitated sexual assault etc. If hair is properly collected at the scene of crime it provides strong physical evidence [3]. Hair can be useful in forensic biology, serology and forensic toxicology branches. In forensic toxicology field various biological specimens are utilized to know the history of drug consumption and related crime.

In previous literature it is reported that routine toxicological analysis for drug of abuse in biological substances like blood and urine provide information only few days to week. In case of chronic poisoning urine and blood samples are not suitable, as these biological matrix cannot distinguish between single and long term exposure of drug hence hair analysis clearly gives an idea about chronic intake of drug.

In some circumstances human scalp hair is not available because of alopecia, shaving, mutilated body fragments in sexually assault cases and premature baldness analyzing hair from alternative anatomical locations becomes necessary. Study of scalp hair in case of genetically hair whitening, esthetic considerations and environmental factors also has its own limitations, to overcome this non scalp i.e. hair from other parts of body plays an important role in drug detection. The aim of this research proposal is to study non scalp hairs in the detection of commonly abused psychoactive drugs which will be an alternative matrix in forensic toxicological analysis.

Hair is a fibrous out layer from the skin of mammals which originate from papillae embedded in the bases of follicles situated in the dermis or true skin. Single hair consists of keratinized cells attached to cell membrane complex, and this arrangement makes three concentric radial structures in hair shafts: cuticle, cortex and medulla [6].

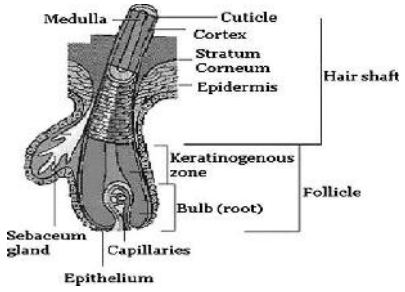

Figure: 1 Hair structure, the associated sebaceous gland and the surrounding tissues

The multicompartment model has been accept in drug incorporation in hair through (1) active and passive diffusion from blood stream feeding the dermal papilla, (2) diffusion from sweat and other secretions bathing the growing or mature hair fiber, or (3) external drug from vapors or powders that diffuse into the mature hair fiber [1].

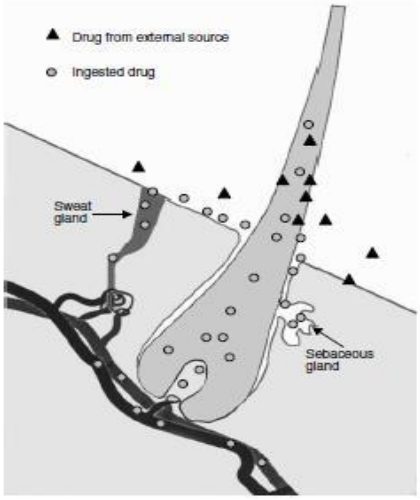

Figure: 2 Three models of drug incorporation

There are number of research papers appeared in the forensic literature related to commonly abused drug analysis in scalp hair but recently few research papers highlighted the use of non scalp hair e.g. pubic hair, beard hair, axillary and body hair for drug identification [18-20]. These studies found to be encouraging and indicates that such study can be very useful in the cases where scalp hairs are not available then it becomes only alternative to use non scalp hair for the drug identification. To understand why researchers are not using non scalp hairs frequently for drug detection may be due to the reasons, firstly the nature of this approach is in initial phase, secondly the validation of this approach is still awaited by scientific community, thirdly because of differences in hair growth of anatomical regions (non scalp) and variation in anagen phase of scalp and non scalp hairs [3] and lastly chances of getting drug in scalp hair is better than non scalp but in situation where scalp hair is not available then only alternative is left i.e non scalp hair analysis for the identification of drug.

REVIEW OF LITERATURE

Henderson G. (1992) proposed multi model of drug incorporation in hair shaft through diffusion from blood to the actively growing follicle, after formation through secretions of the apocrine and sebaceous glands, and after hair has emerged from the skin from the external environment [1].

F. Tagliaro et al (2000) In this study hair samples are screened for opiates (morphine), cocaine and ecstasy, by using radio immunoassays before issued the driving license. All positive samples and about 10% of negatives are confirmed by high-performance liquid chromatography. Further confirmation of results can be carried out by capillary electrophoresis (and/or GC/MS or MS/MS).The results of this integrated diagnostic strategy were reported [2].

Wenning Robert (2000) studied potential problem with interpretation of hair analysis, stated due to differences in hair growth rate depending on anatomical region, age, gender, ethnicity and interindividual variability, interpretation of parent drug or/and metabolite concentration in hair is not easy. Further, as drug incorporation mechanism into hair matrix is not yet fully understood, it is rather difficult to extrapolate details on time and dose from hair segmental analysis [3].

Christe`le Girod and Christian Staub (2000) studied automated solid phase extraction method for extraction of drug and their metabolites from hair samples. In this work characterization of drug and their metabolites were done by GC-MS and GC/ IT/CI/MS [4].

B Bar-Oz et al (2003) detected drug of abuse such as cocaine, benzoylecgonine, opiates, cannabis, benzodiazepines, methadone, and barbiturates in meconium and neonatal hair samples. In this work it found that both meconium and neonatal hair are effective biological markers of in utero illicit drug exposure analysis and concluded that meconium is more sensitive [5].

Khosrou Abdi et al (2004) analyzed opium and their derivatized drug codeine, morphine by using GC-MS. In this study hair samples were collected periodically from opioids abusers and extraction was done by derivatization method [6].

Karl B. et al (2005) compared drug incorporation and melanin concentration in hair. In this work concentration of melanin and drug incorporation shows linear relationship of cocaine and codeine drugs [7].

Vassiliki A. Boumba et al (2006) reviewed the usefulness of hair sample in drug detection in forensic toxicology and clinical toxicology. In this study the specific purpose of the hair testing was discussed along with the interpretation of hair analysis result [8].

Simona Pichini et al (2006) focused on segmental analysis of MDMA in respect of number of tablet taken per month and correlated with the concentration in hair. In this study results proved that correlation existed between number of tablets taken per month doesn't affect the concentration level in hair [9].

Jaydep Sen et al (2010) reviewed about the structure, formation, growth of hair, types of hair and forensic importance of hair in drug of abuse cases [10].

Xiaopei Cui et al (2013) analyzed zolpidem in hair by using ultra high performance liquid chromatography/electrospray ionization tandem mass spectroscopy [11].

Papoutsis I et al (2015) solved a murder case of 28 years girl, where whole body was skeletonised only hair sample was present at scene. Collected hair sample transfer for toxicological analysis and found that the victim was heroin expose [12].

Jan Gryczynski et al (2015) studied utility of hair in testing drug concentration use among individuals with moderate-risk drug use based on the internationally validated Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) [13].

Alberto Salomone et al (2017) utilized a novel method for the examination of prevalence of NPS use in a high-risk population. Hair samples from high-risk

nightclub and dance music attendees were tested for 82 drugs and metabolites (including NPS) using ultra-high performance liquid chromatography–tandem mass spectrometry. Eighty samples collected from different parts of the body were analyzed, 57 of which detected positive for at least one substance-either a traditional or new drug [14].

Joseph J. Palamar et al (2017) examined 90 hair samples of self reported past year ecstasy /MDMA/Molly users attending EDM parties in New York using UHPLC-MS/MS. In this study reported results were 74% positive for MDMA, 33.3% for NPS and 27.8% for synthetic cathinones [15]**.**

Claudia Vignali et al (2018) developed and validated GC-MS method for the analysis of ethyl glucuronide in keratin matrix particularly in hair samples. In this work GC-MS results were compared with LC–MS/MS. This method was applied to 194 hair samples collected from teetotalers and alcohol consumers and represents a suitable alternative to LC–MS/MS for the determination of EtG in hair samples. This study confirmed that pulverization of hair increases the concentration of EtG, but some variability of EtG levels remains probably due to the presence of non-homogeneous material even though pulverization [16].

Thomas James et al (2019) developed, optimized and validated isotope dilution GC–MS/MS method for the analysis of methyl salicylate in human skin and hair samples of volunteer [17].

RATIONALE

Hair evidence plays a significant role in criminal investigations. The forensic toxicological analysis of hair assists in compliance to testing and drug monitoring. The earlier research work investigated the deposition of drugs in scalp hairs for opium, cocaine, benzodiazepines and barbiturates etc. The purpose of this research proposal extends the study on analysis of drug of abuse on non-scalp hairs of forensic interest. Hair analysis is becoming an alternative to body fluids analysis for drug detection since all the samples have provided only short-term information about drug use while hair samples provide a larger field of detection as well as history of

exposure over time. The study incorporates non-scalp hairs in toxicological analysis as it gives a new alternative matrix to body fluids for drug identification. Non-scalp hairs provide susceptible data for drug exposure, which will be helpful to investigating agencies in drug of abuse cases. Practically, hair testing offers significant advantages, as its collection and storage are simple and inexpensive as compared to other body fluids.

OBJECTIVES

The present research work aims to study non scalp hair analysis in the detection of commonly abused psychoactive drugs.

The main objectives of the study are

1. Extraction of drugs from non scalp hair samples.
2. To study qualitative and quantitative analysis of drug of abuse from non scalp hair samples.
3. Comparison of drug concentration in non scalp hair samples.

MATERIAL & METHODOLOGY

Study Design

1. **The Sample-:** Non scalp hair samples will be collected from drug of abusers from rehabilitation centers, hospitals, established institutions and individuals after consent. The samples shall be collected as per standard procedure.
2. **Decontamination of collected sample -:** The first step in the analysis of hair require washing of the collected specimen to remove potential external contaminants. Washing shall be done by standard procedure.
3. **Extraction-**: Extraction of drugs & metabolites will be carried out by solid phase extraction method and other compatible technique.

4. **Purification-:** Purification of extracted drugs and metabolites as per standard procedures.
5. **Qualitative and quantitative -:** Analysis of drugs and metabolites shall be done by using modern analytical instrumental methods such LC-MS/MS and other related chromatographic and spectroscopic techniques.
6. **Comparative analysis-:** Comparative study of non scalp hairs samples to know the drug concentration.

EXPECTED OUTCOME

It is evident that the environmental factors like air pollutants have adverse effect on scalp hair as it is very sensitive, because scalp hair is exposed to environment whereas the other body hairs are not. Soot, dirt, dust and gases can cause scalp irritation, dryness, breakage and even premature baldness, genetically hair whitening, also body chopping in case of sexual assault analysis of non scalp hair will be useful as these are easily available. Hair evidence plays a significant role in toxicological analysis of drugs. The expected outcome of the study will be helpful in detecting drug of abuse cases where other types of evidences are not available. The research strives to develop sensitive analytical procedure to detect drugs from non scalp hair i.e. body parts hair.

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